A REPORT

UPON THE

SANITARY CONDITION

OF THE

Public Schools of Dayton,

WITH SPECIAL REFERENCE TO THE

EYESIGHT OF THE PUPILS.

BY

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Submitted to the Board of Education, March 12, 1880.

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At a regular meeting of the Board of Education for the city of Dayton, Mr. Thresher introduced the following resolution, which was unanimously adopted:

"*Resolved*, That a committee of three be appointed to ascertain whether all of the school-rooms of this city are sufficiently lighted, and whether any conditions are existing, tending in any degree to impair the sight of pupils, and whether weakness of sight is to any extent prevalent among the pupils of the public schools, and that this committee be authorized to incur any necessary expense not to exceed twenty-five dollars."

Dr. Conklin was subsequently added to the committee, to fill a vacancy, and, at our request, prepared and submitted the following report, which is fully endorsed by us.

E. M. Thresher,
J. K. Webster.

Dayton, Ohio, March 12, 1880.

Gentlemen of the Board of Education:

There is perhaps no question, which, within the past decade, has excited greater interest in educational circles than the one contained in the foregoing resolution. The close relationship which exists between school work and impaired vision is now generally recognized. More than fifty years ago the great English oculist, Mr. Ware, pointed out the fact, based upon observations in Cambridge and Oxford, that the amount of near-sightedness increased with the amount of study, and, within certain limits, with the age of the student. It was, however, reserved for Dr. Cohn, of Breslau, to institute the *experimentum crucis* by the examination of the eyes of the school children of his native city, the result of which having now been verified by competent observers in every civilized nation of the globe, has crystallized into facts the vague notions of former years.

It will best serve our purpose this evening to arrange all eyes, so far as their optical condition is concerned, into three classes—normal, far-sighted and near-sighted. Distinct vision necessarily depends upon the rays of light which enter the eye being brought to an accurate focus upon the retina, which is placed upon the posterior wall of the eye, and is the only part of the organ directly sensitive to light. For the sake of simplicity, we may regard the refractive media of the eye, taken collectively, as forming a single lens, the focal length of which is precisely equal to the length of the axis of the eyeball. The

normal human eye may then be defined as an optical apparatus of such form that parallel rays are precisely focused upon the retina, thus imprinting upon this sensitive membrane a sharply defined image of all objects from which these rays emanate. It is quite evident that there is no necessary relation between the axial length and the focal length of the eye.

Supposing, for the sake of illustration, what is only partially true, that the focal length of the refractive media remains constant, it is plain that the axial length or length of the eyeball from front to back, may be altered from the normal type, above described, in two opposite directions, *i. e.*, it may either be *shorter or longer*. If the first condition obtains, the eyeball is no longer a globe but is flattened in its antero-posterior diameter, resembling a turnip in shape, and, as an inevitable result, parallel rays of light entering the eye are brought to a focus *behind*, not upon the retina. This malformation is known as the flat, or far-sighted, or hypermetropic eye. When the second condition is present, the antero-posterior diameter of the eye is increased by the bulging backward of its posterior wall, hence parallel rays are focused at a point in *front* of the retina. This malformation is known as the long or short-sighted, or myopic eye. In either case the result is the formation of an indistinct image upon the retina and an inevitable impairment of vision. These two defects differ as widely in their usual mode of origin as they do in their physical characters. Hypermetropia or oversightedness is due to an arrest of development, and is therefore a congenital not an acquired

condition. Myopia or near-sightedness, on the other hand, is very rarely congenital, but is produced by well known causes, many of which, as we shall presently see, are closely connected with school work. Near-sightedness, moreover, when progressive, is a disease which threatens the integrity of the eye since the elongation of the ball is always attended with serious alterations in the deeper structures. Thus the retina, than which no organ of the body is of more complicated and delicate mechanism, measuring with its several distinct layers less than 1-200th of an inch in thickness, is thinned, altered by congestion, inflammation, effusion, and other morbid processes, which necessarily impair and occasionally destroy its functions.

We have thus far considered the eye simply as an optical instrument arranged for parallel rays. In point of fact, however, rays of light which are parallel, or approximately so, are only emitted from objects removed some distance from the observer. From all objects less than twenty feet distant the rays of light which enter the eye are divergent, and since the retina cannot move backward to the point at which these divergent rays come to a focus a change must necessarily take place in the eye to increase its refractive power. This change, which is known as *accommodation*, is secured through the action of a circular muscle in the interior of the eye called the ciliary, or muscle of accommodation. The accommodation is to the eye what the adjustment is to the microscope. In the normal-sighted eye, this little muscle performs its duty without any unpleasant sensations, but in the far-sighted eye the conditions are very different. Here the already

too flat ball gives rise, even for parallel rays, as we have just seen, to a disparity between the axial and focal lengths of the eye and this disparity is of necessity largely increased for divergent rays; as the result, the ciliary muscle of the over-sighted eye knows no rest. No object, *near or far* can be seen distinctly without its aid. This constant and excessive use necessarily tires the muscle, interferes with its proper nutrition and eventually leads to its permanent disability. While care will do much to postpone the ill effects of such a malformation, an hypermetropic eye will sooner or later become painful and vision indistinct, even under ordinary use on near objects. Hypermetropia is, therefore, a very serious impediment to a pupil in his school work, but we, as a Board are more deeply interested in the acquired and preventable disease—myopia—to which our discussion will hereafter be restricted.

The fact seems established beyond controversy that near-sightedness increases in every country just in proportion as it grows in mental culture. In barbarous tribes it is almost unknown. British surgeons have failed to find a single case of myopia out of thousands of examinations of the natives of British India. A similar immunity from this disease is found among the freedmen of our own country. On the other hand, it is shown that nearly seventy per cent. of those who graduate from the public schools of Germany are near-sighted, and statistics indicate that America is in a fair way to wrest from Germany the doubtful honor of being the shortest sighted nation on the globe.

The sad story revealed by the vast number of examina-

tions of the eyes of school children, made within the past few years, almost forces us to accept as true the gloomy prophecy of Ribot: "That since constant study creates myopia, and hereditary influence most frequently perpetuates it, the number of short-sighted persons *must necessarily increase* in a nation devoted to intellectual pursuits."

The question then meets us on the very threshold of our inquiry, is a diseased and crippled eye the necessary price of a liberal education? Modern science teaches positively that myopia is largely, if not entirely, a preventable disease. And, moreover, the principles of eye hygiene are so plain and simple that any pupil of average intelligence can understand and apply them. The use of the eye within physiological limits—tends to strengthen and develop it. As a general proposition, it may be stated that there is nothing in intellectual pursuits, followed in a proper manner, which necessarily results in the impairment of any organ of the body.

It may be well to emphasize the fact here that, while near-sight is developed almost exclusively during school life—rarely afterwards and very rarely indeed before that time—there are other factors in the production besides those connected with school work. Many of the causes which are operative in the school room are more active in the child's home, supplemented oftentimes by causes unknown in the former place.

The fact which is of the utmost practical value, and which is, perhaps, one of the most important which can be impressed upon the attention of parents and educators, is that short-sightedness is *essentially a disease of youth.*

The period of its most frequent development ranges from the tenth to the fifteenth year of life.

Previous to the seventh or eighth year of age myopia is the result of disease; after the age of sixteen or eighteen when the investing membrane of the eye has become firm and unyielding, over-study may develop other and graver diseases of the eye, but it will not cause near-sightedness. Professor Donders, the highest authority in the world, has never known a case of myopia to originate after the twentieth year of age, and Professor Erismann's experience is the counterpart of that of nearly all ophthalmologists, that it very rarely begins after the fifteenth or sixteenth year of life. In this connection we would again forcibly impress the close relationship existing between the question of near-sightedness and that of physical development in its broadest sense. Whether or not a child under given circumstances will develop myopia, depends largely upon the general robustness of the child. The body may be looked upon as a physiological unit, every organ of which recognizes the same general laws of growth, development, nutrition and functional activity. "Since the eyes are integral parts of the organism as a whole, it follows that their comfort is inseparably bound up with its general welfare, and that they are liable to share in all morbid conditions either of body or mind." From these facts the inference is plain, that the high percentage of myopia found in the examination of school children, does not represent alone the influence of the school and its environments, but is the sum of all the anti-hygienic surroundings of the child during the years covered by its school life.

In following out the instructions of your resolution, we have examined the eyes of 765 pupils attending the city schools, distributed as follows: Second District, 168; Third District, 67; Fourth District, 98; Intermediate, 153; High School, 279. The results obtained are shown in the following table:

TABLE I.

SECOND DISTRICT.

	Pupils.	Per cent.
Normal	143	85.12
Abnormal	25	14.88
Myopic	19	11.30
Hypermetropic	6	3.56
Myopic { Girls	11	11.11
Myopic { Boys	8	11.59

THIRD DISTRICT.

Normal	54	80.65
Abnormal	13	19.40
Myopic	11	16.41
Hypermetropic	2	2.99
Myopic { Girls	6	18.18
Myopic { Boys	5	14.38

FOURTH DISTRICT.

Normal	76	77.56
Abnormal	22	22.44
Myopic	18	18.36
Hypermetropic	4	4.08
Myopic { Girls	11	20.75
Myopic { Boys	7	15.55

INTERMEDIATE.

Normal	121	79.09
Abnormal	32	20.91
Myopic	27	17.65
Hypermetropic	5	3.26
Myopic { Girls	15	21.73
Myopic { Boys	12	15.19

HIGH SCHOOL.

		Pupils.	Per cent.
1st Year	Normal	102	.80.31
	Myopic	20	.15.77
	Hypermetropic	5	3.94
2d Year	Normal	53	.76.81
	Myopic	14	.20.30
	Hypermetropic	2	2.90
3d Year	Normal	38	.73.08
	Myopic	12	.23.08
	Hypermetropic	2	3.84
4th Year	Normal	24	.77.42
	Myopic	7	.22.57
	Hypermetropic		
Total Normal		297	.77.77
Total Abnormal		62	.22.22
Total Myopic		53	.18.96

From this table it will be seen that the percentage of near-sighted children in the District Schools is 15.35 per cent.; in the Intermediate it is 17.65 per cent per cent., and in the High School reaches 18.32 per cent.

The percentage recorded above for the District Schools is very probably too high, due to accidental causes; one of which, as it unquestionably affects the result obtained, may be mentioned here.

I refer to the accidental grouping of myopes in a particular room.

For example, in the Third District the examination of the pupils in the sixth and seventh grades did not discover a single myope, while in the fifth grade there were found eleven thus affected. A similar condition of things was found in the Fourth District. In one room, with a population of thirty-five there were eleven near-sighted, nearly thirty-two per cent. The effect of this on the general average is readily seen. Very probably, the result given in the

Second District, 11.3 per cent., more nearly approaches the percentage which would be obtained by an examination of a larger number of pupils in the several districts.

It may be interesting to record here for comparison the results of similar investigations in other cities:

Cincinnati, 630 students; District Schools, near-sighted, 10 per cent.; Intermediate, 14 per cent.; Normal and High, 16 per cent.

Brooklyn Polytechnic, 300 students: Academic department, 10 per cent.; Collegiate department, 28 per cent.

New York College, 549 students; Introductory class, 29 per cent.; Freshman, 40 per cent.; Sophomore, 35 per cent.; Junior, 53 per cent.; Senior, 37 per cent.

Buffalo public schools, 1,003 pupils; the percentage of near-sightedness increased from 5 per cent. at seven years of age to 26 per cent. at eighteen years. It was further ascertained that one out of every four graduates of the Buffalo High School was near-sighted.

Dr. Derby in a recent paper shows from careful examinations of classes in Amherst College that the percentage of emmetropia (normal) on entrance is 50.8; on graduation four years later, 36 per cent. The percentage of hypermetropia on admission is 5, on graduation 13.2 per cent.; that of myopia, on admission, 44.2; on graduation, 50.8 per cent.

Statistics are often like a two-edged sword, the unskillful wielding of which may injure friends as well as foes, but there does not seem to be any escape from the conclusion:

First, that the percentage of short-sightedness increases,

as a rule, proportionately with the advancement in the school grades.

Second, that the Dayton schools offer no exception to the rule.

We next invite your attention to a brief consideration of the causes leading to this lamentable result, with the view of ascertaining whether or not any of these causes operating in our schools are removable.

For our purpose this evening, the causes of near-sightedness may be arranged in three groups:

1. All those causes which, by a lowering of vital stamina, predispose to the development of myopia—as inheritance, impure air, improper food, &c.

2. All those causes which subject the eyes to excessive and prolonged strain—as defective light, bad type, pale ink, greasy slates, poor blackboards, &c.

3. All those causes which produce congestion of head and eyes—as prolonged use without intermissions, faulty position of body, faulty construction of school furniture, &c.

So far as the influence of heredity is concerned, we will simply say, that while it is an established fact that short-sightedness is an hereditary disease, it by no means follows that the children of myopic parents are born near-sighted. Here, as in most other ailments, it is not the disease itself but a *predisposition* to the disease which is transmitted. Whether this predisposition is developed into actual disease or not, depends very largely upon external conditions; of course, the stronger the birth inheritance, the feebler need be the exciting causes.

The evil effects of impure air on the general health is

too well known to need attention here, but its agency in the impairment of the eyesight is generally ignored. Bad air indirectly favors that laxity of tissue, which in the eye finds expression in the distension of the investing membranes, by which the globe is lengthened from front to back and near-sightedness produced, but it also has a more direct action. Dr. Loring, before the New York Medico-Legal Society, gave it as his opinion: "that bad air alone, acting as the primal cause, may set in motion a series of morbid processes which may, and often do affect not only the working capacity of the organ, but which may even lead to its total destruction." A full consideration of this subject would open up the whole subject of school ventilation, for which we have neither time nor inclination.

A pretty thorough examination of all our school buildings shows that with the exception of the buildings in the Seventh and Ninth Districts, there is not one which has any adequate provision for ventilation. We feel that the Board may well congratulate itself upon the possession of such buildings as those above mentioned. Aside from the heating apparatus, we are inclined to look upon the Seventh District house as the model one; but they are both abundantly worthy of the noble púrpose to which they are dedicated, and very fully meet the requirements of sanitarians in their construction.

Experience abundantly proves that in our climate, at least, ventilation by windows and doors is a delusion. In every large building some system of forced ventilation must be adopted; and as to the special system, each building should be a law unto itself. However, as Dr. Lincoln

puts it, no system will act automatically; brains, as well as fuel and iron, must be used to secure proper ventilation.

In several of the older school-houses, there is a small wooden shaft running up through each tier of rooms; this box usually has a small opening in each room, but occasionally this opening has been closed up, and it contains no provision whatever for securing an upward current. This shaft is usually placed in a corner, between two windows, so as to render the access of what air is pleased to enter as difficult as possible. The foul air is supposed to understand that the shaft is made for its special use, and to be so considerate of the welfare of the children as to hunt up the openings and quietly wend its way into the—*garret* (as in the First District), where it is cooled and returned to the school-rooms more contaminated than ever to complete its vicious circle.

Before dismissing this subject we wish to call attention to the condition of the building in the Sixth District. We make special mention of this house for the reason that since it is one of the most costly, largest and newest of the school buildings, it is certainly a legitimate subject for criticism. Its elevated location and large per capita cubic air space should make it one of the best instead of one of the poorest ventilated and lighted school-houses in the city. The local committee has been forced against its better judgment to create additional rooms by partitioning off portions of the main hall on the second and third floors. For this reason, as it now stands, the main hall does not reach an outside wall, excepting on the ground floor.

Consequently there is an immense volume of stagnant and impure air in the large rotunda, which can scarcely be changed with a hurricane.

Dr. Neal, Health Officer of the city, accompanied us on one of our visitations, and at 10 o'clock on a bright Monday morning the olfactories could readily detect this stagnant air. The entrance to the several study-rooms is through narrow clothes-closets about three feet wide. These closets have no openings whatever excepting into the school-rooms. The effect of this arrangement upon the air of the room, especially during wet and murky weather, and the increased liability to the spread of contagious diseases, are too apparent to need further comment. The only provisions for ventilation contained in the building are six wooden ducts, which, starting on the third floor, descend through these closets into the cellar, and thence pass underground into a ventilating shaft which surrounds a smoke-stack. Unfortunately, however, the system of heating, of which this stack formed a part, was abandoned several years ago. These air ducts measure 16x18 inches, and have a single opening 6x12 inches into each room. When you recall the size of this building and remember that it contains a population of over eleven hundred children, and has an air capacity of about 350,000 cubic feet, the system adopted here may be aptly christened the Liliputian system of ventilation.

It does not appear whether moral suasion is to coax or corporal punishment to compel the foul air to undertake the subterranean trip to the stack, which, wrapped in the weeds of mourning, stands a solemn monument of blasted

expectations and past usefulness. At any rate, the provision is wholly inadequate, and should receive the early attention of the Board.

The members of the second group of causes, so far as their operation is concerned, may be reduced to one, viz.: defective illumination. There is no longer any room for doubt that insufficient and ill-arranged light is one of the most potent factors in the causation of myopia. Dr. Cohn's elaborate investigations in the German schools led him to the conclusion, "that the narrower the street in which the school-house was built, the higher the opposite buildings and the lower the story occupied by the class, the greater the number of near-sighted scholars." Dr. Howe, in the examination of the Buffalo schools, already referred to, found "that in schools where the hygienic conditions relating to the position of the pupils and the amount of light are disregarded, the proportion of near-sighted pupils grows larger, and conversely, where these relations are observed the number diminishes." For obvious reasons the study-room should be the best lighted of rooms; every part of it should receive light enough for a pupil safely and comfortably to perform his allotted task on the cloudiest day. School discipline does not admit of frequent changes in position to accommodate the ever varying illumination of a badly lighted room.

Two problems prominently present themselves for solution: First, the quantity of light needed; and second, the direction from which it shall be admitted into the room. As to quantity, it may be safely said that in our climate illumination by diffused light never attains, even in the

open air, to an injurious intensity. The question then really narrows itself down to, what is the minimum quantity of light that will suffice for school purposes?

Here the requirements of sanitary science are very exact. The German authorities estimate that a class-room containing twenty persons should have at least from 4,000 to 6,000 square inches of glass, which would allow for each scholar a lighting surface equivalent to a pane of glass from fourteen to seventeen inches square. English and American authorities consider this estimate too low.

We are aware that conclusions based upon abstract calculations will often fit the necessities of a given case as poorly as did the famous coat made by the tailor of Laputa according to abstract principles fit Captain Gulliver, but they certainly offer us the best working data to be obtained.

Assuming then that 350 square inches of glass per capita is the minimum lighting surface, Table II. shows how poorly our school-rooms conform to the standard. It is here shown that only two out of the thirteen public school buildings fully meet the requirement, while there are four in which every class-room is defective in the amount of lighting surface.

There are one hundred and sixteen study rooms in the several buildings, of which only thirty-seven, or less than one-third, reach the assumed standard; of these thirty-seven rooms twenty-two are found in the Seventh and Ninth buildings.

TABLE II.

Showing the square inches of window surface per capita.

DISTRICTS.	Total number of rooms in building	No rooms in which the per capita lighting surface reaches or exceeds 350 square in.	No. rooms in which the per capita lighting surface falls below 350 square inches	Smallest per capita lighting surface in square inches	Largest per capita lighting surface in square inches
First	9	3	6	250	667
Second	11	1	10	229	426
Wilkinson	4	0	4	266	326
Third	8	2	6	194	384
Fourth	8	0	8	215	330
Fifth	15	1	14	135	360
Sixth	18	1	17	166	361
Seventh	12	12	0	456	647
Eighth	4	0	4	182	343
Ninth	12	12	0	416	728
Tenth	3	2	1	326	720
Intermediate	4	0	4	236	307
High School	8	6	2	298	412

This table is based upon the number of sittings in each room. It may be properly objected to this method of estimating the lighting capacity, that in many of the schoolrooms, through pressure for the admission of pupils, the number of sittings have been increased above the actual floor capacity. We have therefore, in Table III. calculated the proportion which the window surface bears to the floor

space in the several rooms; the results thus obtained are, in our opinion, of much greater scientific value.

There is a pretty general agreement among the authorities on school hygiene that no building even when entirely free from any possible obscuration, can be considered properly lighted with a window surface, taken collectively, less than one-sixth of the floor space. Many sanitarians place the proportion higher. Dr. Cohn estimates that for each square foot of floor space there should be thirty inches of glass, excluding sash work: a proportion of a little over one-fifth. The committee,* in awarding the prizes recently offered by the *Plumber and Sanitary Engineer* for the best designs for school-houses in the city of New York, expressed their opinion that for a school building in a large and densely populated city, the window space in each class-room should not be less than one-fourth of the floor space. Dr. Lincoln, of Boston, so well known in matters of school hygiene, places the proportion at one-sixth. In a private letter to the writer, Dr. Billings, of the United States Army, who stands at the head of sanitarians in this country, says in substance: when the school-house has plenty of surrounding space, and has its rooms properly proportioned with square-headed windows, coming up close to the ceiling, if the window surface is one-sixth of the floor surface it is enough. But if the location be such that there is liability to obscuration from any cause whatever, even from the smoke of a manufactory, the proportion must be made higher. From our observations in the Ninth District build-

*See Appendix II.

ing, in which the window surface is one-sixth of the floor space, we believe that when the access of light is perfectly unobstructed this proportion is sufficient and have, therefore, taken it as the standard in preparing this table:

TABLE III.

Showing the proportion of window surface to floor surface.

DISTRICTS.	Total number of rooms in building	No. of rooms in which window surface reaches or exceeds ⅙ of floor space	No. of rooms in which window surface falls below ⅙ of floor space	Smallest proportion between window and floor space	Largest proportion between window and floor space
First	9	6	3	1-9	1-6
Second	11	0	11	1-12	1-7
Wilkinson	4	0	4	1-10	1 7
Third	8	0	8	1-10	1-9
Fourth	8	0	8	1-11	1-7
Fifth	15	0	15	1-16	1 9
Sixth	18	0	18	1-12	1-7
Seventh	12	12	0	1-5	1-4
Eighth	4	0	4	1-11	1-11
Ninth	12	12	0	1-6	1-6
Tenth	3	3	0	1-6	1 6
Intermediate	4	0	4	1-11	1-7
High School	8	6	2	1 7	1-5

From this table we learn that the buildings in the Seventh, Ninth and Tenth Districts conform, in all of their study-rooms, to the standard. It is a source of gratification to know that these houses are the last ones erected

for school purposes in the city, all having been built within the past five years. The High School and First District houses also make a comparatively good showing, but in the case of the latter there are other conditions, some of which will be presently mentioned, which really make it very imperfectly lighted.

We shall not attempt to specify in detail the alterations needed in the various buildings, but certainly the disabilities of many of them are so great as to need urgent attention. There are, in fact, a few rooms which are totally unfit for school purposes and should be abandoned at once.

Even when the openings are sufficient for the admission of plenty of light, trees and neighboring houses may defeat the end. No building can be properly lighted, especially in its lower stories, unless there is reserved on every side a strip of inalienable ground, the width of which is double the height of adjacent buildings.

The First and Second District buildings are notoriously bad in this respect; the Third and Fourth will not bear criticism.

The proper position of windows is now tolerably well settled. No window should ever be placed in front of the scholars; the light coming through it is not only useless, but absolutely injurious. Light entering from the front causes the pupil of the eye to become unduly contracted, which is precisely equivalent to a reduction in the quantity of light, and furthermore, irritates and fatigues the retina by the full glare upon it.

Light from behind alone is exceedingly bad, since the

book is constantly in the shadow of the head and the upper part of the body. The very best light for school work is that coming over the left shoulder, but if the two prime requisites are fulfilled—abundance of light and the exclusion of windows from the front—there is no very serious objection to its admission from either side and the back. There is some discrepancy of opinion as to the comparative value of unilateral and bilateral windows. It seems to us that the question hinges largely upon the width of the room and the construction of the windows. Sufficient light can only be obtained from windows arranged upon one side when the width of the room does not exceed the height of the lintels of the windows above the floor. If the width exceeds this measurement, bilateral windows become necessary for proper lighting.

For school purposes that light which strikes the desk at something near a right angle is decidedly to be preferred. All windows should, therefore, be square-headed, and beginning above the tops of the desks should extend, as nearly as possible, to the ceiling.

As aiding in the attainment of this condition, the ceilings should always be white, and it is also desirable to have the walls tinted with some light, neutral color. That blackboards should not be placed between windows, if intended for ordinary use, is too self evident to need discussion. These simple requirements, so far as Dayton school-houses are concerned, are certainly too frequently ignored. We shall not attempt to specify the rooms falling below the standard. In the placing of windows, the various architects seem to have been animated by some-

thing of the Irishman's spirit at Donnybrook, where a vacant space exists, *go for it* with a window.

The third group of causes presents us with many important subjects for consideration; however, we shall for want of time confine ourselves to, first, the effect of prolonged tension of accommodation, and second, the effect of a faulty position in studying.

We have already incidentally referred to the action of the ciliary or muscle of accommodation, in bringing diverging rays of light to a focus upon the retina. This is done by increasing the curvature of the crystalline lens, rendering it more convex and thereby shortening its focal length. If we had but one eye this would be sufficient, but for binocular vision it is necessary that the visual lines of each eye shall be directed to the same point. This act is called *convergence*, and is effected by the harmonious action of the external muscles attached to the eyeball.

The degree of convergence must necessarily vary according to the distance of the object looked at. The action of these muscles in effecting convergence is to bring strong lateral pressure upon the globe, increase the intra-ocular pressure, and thus cause severe strain upon the posterior pole of the eye. Under habitual and long continued pressure, without sufficient intermissions, the tunics of the eye yield, the ball becomes too long, and this elongation is the essence of near-sightedness. This leads up to the point we are endeavoring to impress, that teachers and parents should be careful in imposing visual tasks upon young children. We will repeat again what has already been said, that youth is emphatically the seed-time

of the harvest of disability, discomfort, and perhaps blindness, which is so often reaped in later years. The practice of beginning in early youth the study of foreign and ancient languages, necessitating the use of badly printed dictionaries, or upon map work in which names are scarcely legible, can not be too strongly condemned.

Dr. Loring says: "If it be true that continued tension of the muscular and nervous force unduly exhausts the energy of an organ, it is doubly true of the eye. The nervous energy of the retina, sensitive and rapid as it is, is just as rapidly exhausted. No eyes, in my opinion, should be used more than an hour at the farthest in the act of reading or writing without an interruption of the gaze, and it would be better if several interruptions should take place in the same time."

If the causes above specified will alone develop myopia, the question may suggest itself: Why is this anomaly not more often developed among artisans whose employments involve similar conditions? The exemption has been very properly attributed to the fact that the apprentices of skilled labor do not usually engage in the niceties of their trades until after the sixteenth or eighteenth years of age, when, as we have already stated, the liability to the development of myopia is vastly diminished. The fascination, too, which attends reading and other mental occupations is more apt to lead to greater excesses than attends merely mechanical pursuits.

The evil influence of faulty positions of head, body and book on the visual organs is fully recognized by all competent authorities. In accordance with a well-known

physical law there is an increased flow of blood to any organ during its functional activity. A stooping posture acts mechanically, by compressing the abdominal viscera, to prevent the free return of the blood from the head and eyes. Frequently repeated and long continued, this position transforms a normal hyperæmia into an abnormal congestion; this congestion leads to softening of the coats of the eyeball which readily yield to forces and in a manner already mentioned. One of the very first points in the hygiene of myopia is to avoid working in a stooping posture. In all school exercises the erect position should be strictly enforced. The book should never be held nearer than twelve inches, and always as nearly as possible in the same plane with the eye.

When visiting rooms in which the pupils were engaged in writing and slate work the position of the body and book pretty generally violated the above maxims. The fault may be, and often is due:

First, To a bad habit. In one of the rooms a boy was pointed out by the principal and teacher as being near-sighted. They formed that opinion from the manner in which he nosed his work. An examination, however, showed that his eyes were not myopic, and that beyond doubt the injurious position was merely the result of habit.

Second, To defective illumination, which has already been sufficiently discussed.

Third, To the faulty construction of the furniture in the school-room. Let us consider this last factor somewhat in detail.

It has been abundantly shown from anatomical reasons

alone, that a child cannot for any length of time maintain a correct posture with unsuitable seats and desks.

From our examinations, we believe the faults most frequently found in the fittings of our school-rooms are:

1. The desks are too high.

2. The difference between the height of seat and that of the desk is too great.

3. Too great a distance between the seat and desk.

4. The top of the desk is too flat.

5. The size of the seat and desk is not always suited to the occupant.

The seat should always be broad enough to support the whole length of the thigh, and its height such as to permit the feet to rest firmly upon the floor. The desk should overhang the seat at least one or two inches. This construction brings the desk so near the child's body that he is almost compelled to sit erect when engaged in slate or manuscript work. This requirement has been generally ignored in placing the furniture in the various rooms. Not infrequently perpendicular lines drawn from the edges of seat and desk were from two to three inches apart. With a sitting thus placed, the child engaged in desk work is compelled to sit on the edge of the seat, and, still worse, to assume the position of body which we have already pointed out as such an important factor in the causation of near-sightedness. The edge of the desk should be just high enough to allow the elbow to rest upon it without elevating the shoulders. Unless this rule be observed, it is a physical impossibility for a pupil to write without being compelled to twist the spine, and at the same time look

sideways at his manuscript, which imposes a heavy tax upon the muscles of accommodation. The twisting of the spinal column just mentioned is a defect too important in its influence upon the child's health and figure to be passed without comment. We can perhaps impress our meaning no more forcibly than to quote the following paragraphs from Prof. Liebreich: "To be in such a position for several hours of the day, at a time when the youthful body is developing, must naturally produce permanently bad effects. Statistics prove this to be the case. In Switzerland, for instance, twenty per cent. of all school boys and forty per cent. of girls have one shoulder higher than the other. The well known orthopoedic surgeon, Eulenberg, also states that ninety per cent. of curvatures of the spine, which do not arise from special disease, are developed during school life. These statements have particularly struck me as coinciding directly with the period of development of short-sightedness, and I have paid the more attention to this relation between spinal curvatures and short-sightedness, as they seem to form a *circulus vitiosus*, in so far as short-sightedness produces curvature and curvature favors short-sightedness, while evidently the same bad arrangements are at the foundation of both these anomalies."

The desks in common use do not slope sufficiently. The highest authorities agree that for prolonged use a desk which retains the work at an inclination of about forty-five degrees, places the visual muscles under the most favorable conditions for performing their functions. This inclination would however, be manifestly inconvenient for

writing. Liebreich considers an inclination of twenty degrees as a proper one for manuscript work. These conclusions, based as they are upon physiological facts, indicate that all desks should have a slope of at least twenty degrees, and that the additional inclination proper for reading should be obtained by means of some mechanical device, the simplest of which is some form of book-rest.

It is important that the book of a near-sighted child should be held at even a greater angle than is here specified. If we now add to this skeleton seat proper support for the back, sloping slightly and reaching almost to the shoulders, we will have constructed, what may be termed from a sanitary point of view, the model seat and desk for the school-room. It is not enough, however, that the school sitting should conform to the recognized standard in its construction, but it is equally important that it shall be suited to the individual pupil. Most of the rooms are provided with seats graded to meet the wants of the differently sized scholars, and teachers should exercise care in the assignment of the sittings.

Now, Gentlemen of the Board, if you accept as true the statements made in the body of this report, our duty is plain. That badly lighted, badly constructed and badly furnished school-rooms form a powerful machinery for the development of short-sightedness, may be accepted as an established fact. It is a duty, then, we owe alike to parents and children to banish these causes, as far as lies in our power, from the schools under our supervision. But the removal of these merely mechanical matters will not eradicate the evil, nor will it supersede the necessity for

the constant supervision of a competent teacher. We have already expressed our positive conviction that many of the causes of impaired vision specified in this report are more active in the child's home than in the school-room. But are we not able to reach the home? The shortest route to the family circle is through the school-house. The teacher's influence and power for good is not hemmed in within four walls, but radiates into and permeates through every home in the land. When teachers become thoroughly aroused to the importance of the physical development of the young, then and then only, will education become in fact, what the root signification of the word implies—a *leading out*, a developing of all the faculties, *mental*, *moral*, and *physical*. But if we are to enlist the intelligent and hearty co-operation of teachers, without which our efforts at reform will avail nothing, it is absolutely essential that some provision be made for instructing them in the fundamental principles of school hygiene. This is to a large extent special knowledge, and therefore not readily attainable. The Normal School at once suggests itself as the eminently proper place for acquiring such knowledge. Most certainly the subject of school hygiene should occupy a prominent place in the curriculum of a school destined to fit teachers for their special work. We would earnestly urge upon the Board the necessity for instituting such a course of instruction in our Normal School.

APPENDIX I.

Your committee recommend that the following rules for the care of the eyes be printed in large type upon cardboard, and conspicuously placed upon the wall of every school-room in the city:

1. Do not read, write or sew with insufficient light; with the light coming directly from the front; with sunlight upon your work, or in twilight.

2. Avoid a stooping posture; sit erect when you read or write; do not lie down to study.

3. Hold the book from twelve to fourteen inches from your eyes; keep the page, as nearly as possible, perpendicular to the line of sight.

4. Do not read in street or railroad cars when in motion.

5. Do not read any book or magazine which is badly printed on poor paper.

6. When engaged in prolonged study or your eyes become painful, rest them frequently by looking at distant objects.

APPENDIX II.

The editor of the *Plumber and Sanitary Engineer*,* recently offered valuable prizes for the best designs of a public school house in the city of New York. A large number of plans was entered for competition. The Committee of Award was composed of gentlemen well known to the public and justly eminent in the several callings to which they belong. The conditions under which this competition was made are very different from those which obtain in our city, where eligible school-sites with abundant vacant space surrounding them are easily secured. For the present, at least, we are firmly convinced that no more than two of the floors of any school building should be occupied for study rooms. However, we believe that the requirements of the model sanitary school house, as set forth by the committee in the following propositions, are of sufficient public importance to justify their insertion here.

It is the opinion of the committee that a public school building to be erected in a large and densely populated city should possess the following qualifications, viz.:

1. At least two adjoining sides of the building should be freely exposed to light and air, for which purpose they should be not less than sixty feet distant from any opposite building.

2. Not more than three of the floors should be occupied for class-rooms.

3. In each class-room not less than fifteen square feet of floor area should be allotted to each pupil.

4. In each class-room the window space should not be less than one-fourth the floor space, and the distance of the desk most remote from the window

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should not be more than one and one-half times the height of the top of the window from the floor.

5. The height of a class-room should never exceed fourteen feet.

6. The provisions for ventilation should be such as to provide for each person in a class-room not less than thirty feet of fresh air per minute, which amount must be introduced and thoroughly distributed without creating any unpleasant draughts, or causing any two parts of the room to differ in temperature more than two degrees F., or the maximum temperature to exceed seventy degrees F. This means that for a class-room to contain fifty-six pupils, twenty-eight cubic feet of air per second should be continuously furnished distributed and removed during school sessions. The velocity of the incoming air should not exceed two feet per second at any point where it is liable to strike on the person.

7. The heating of the fresh air should be effected either by hot water or low pressure steam.

8. The fresh air should be introduced near the windows; the foul air should be removed by flues in the opposite walls.

9. Water closet accomodations for the pupils should be provided for on each floor.

10. The building should not occupy more than half the lot.

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Committee of Award.